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STANDARDS AND ENGINEERING EFFICIENCY

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STANDARDS AND ENGINEERING EFFICIENCY

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1. Engineering tends often to be looked at very narrowly as the part of industry that makes or uses factory plant and equipment such as machine tools, boilers, turbines, electric motors, cranes, steel sections and the like. But in fact some aspect of engineering enters into every activity of industrial and commercial life and increasingly into agriculture and the exploitation of natural raw materials. Engineering efficiency in its widest sense is of vital importance to the development of any country even though that country may have little interest in producing any elaborate or complicated items of engineering equipment. But it will certainly need much engineering equipment for the economic functioning of its local industries, for production of building materials and the construction of factories. It must also develop its transport, its roads, its communications and its power supplies, exploit its minerals or timber, and ensure the quality of its exports to pay for the capital equipment it imports. All this means engineering, and to operate efficiently in this field, as well as to profit from the engineering experience of others, demand standards.

2. The value of standards as one of the indispensible tools in engineering is generally accepted as self-evident, but it is necessary to emphasize that as for any other tools, their nature and use has to be studied and learned. Standards are often complex documents both to prepare and to use. They may classify materials, define a range of qualities or grades, lay down how to test them and assess the results, or specify the dimensions, performance and ratings of components and machines, and the maintenance and operation of equipment. Their value depends largely on their wide acceptance and whilst themselves a disciplining factor their use requires industrial, indeed national, discipline.

3. The wide scope of activities in the economy of any country into which engineering enters underlines the importance of the adoption of common engineering standards and practices as a national policy. Government departments placing orders abroad and at home for materials and equipment, individual firms or public authorities manufacturing and providing services, will benefit from standards in their own sphere, but

common standards will bring the still wider benefits of interchangeability, a common technical shorthand and an integrated industrial economy ensuring effective use of national resources of raw materials.

4. The setting of standards for the products of any country - whether they be processed or natural products is of great importance in providing targets as a means of encouraging the general improvement of the quality marketed. Indeed some countries are adopting the policy of fixing higher standards for their exports than for home production and are taking steps to ensure that the products exported do in fact comply with such higher standards.

5. Engineering standards have been produced in all the highly industrialized countries of the world for many decades. They are constantly being reviewed and revised to keep abreast of progress and new standards are introduced as new materials and techniques are developed. The perennial problem is to know at what stage in a rapidly developing industry, such as electronics, to set the standards which will determine the design of equipment, or when a change in a well-established standard is called for because of changes in techniques or the uses to which materials and equipment are put. A country setting about the task of establishing national standards at any point of time will have to resolve similar problems even if it uses, as it will obviously do, the material available in other countries' standards and in internationally agreed recommendations. It will have to select what is appropriate to its own conditions (whether of climate or industrial skill), the range of types, sizes and qualities to be used or manufactured.

6. In addition it will have to institute or expand its research and testing facilities in order that the special problems of its production and use of materials can be investigated, and in order that testing of materials and products can be carried out to ensure that they are of the required quality, accuracy or other characteristics. The results of research and investigation can best be used and disseminated to producers and users of materials and products through the medium of standards of national application. For the basic equipment for testing and research, and for the methods to be used, guidance can be drawn from existing standards and international recommendations.

7. If the implementation of standards is to be effective they must be drafted along lines which will secure full acceptance on the part of those who are to use them, whether as manufacturers or purchasers. Hence the procedure for preparing standards which is generally adopted by standards organizations throughout the world is that of forming representative technical committees to be responsible for drafting and of seeing that opportunity is given to all interests to comment on the drafts before they are finally adopted as national standards.

8. This means that the organization required, whether functioning as part of a Government Department or independently, is one which will effectively represent producing and using interests, those concerned with Government and other public services and the technical advisory services which are available.

9. Even with general co-operation in the formulation of standards, there is still much to do done to secure their full adoption. Should they be imposed by law or their use be left to the good sense of purchaser or producer, reinforced by persuasion and publicity measures? Making standards obligatory is on the face of it very attractive and is certainly desirable in cases where safety or health are at stake: no one would question that standards for the protection of dangerous machinery and for the protective clothing of workers in dangerous occupations should be imposed by law. But for the rest, there are serious disadvantages in requiring compliance with the whole complex of national standards. The effect is almost inevitably to draft minimum standards, and to induce inflexibility, since legislative amendment of standards tends to be slow. Moreover the dilemma arises that obligatory standards, if not policed, will fall into disrepute or if policed adequately will impose an excessive burden on the economy. Some compromise therefore needs to be reached, and a decision made as to the standards which it is desirable, and economically practicable, to enforce. In any event everything is to be gained by making all those who use standards recognize that they have a responsibility to support and collaborate with the national standards organization. To ensure this, resources are required for publicity, information and technical services, as well as for advice and help in applying standards in the individual firm or organization. Most standards bodies recognize this and have expanded their functions, originally limited to the preparation of national standards, to include a wide range of services directed to the efficient application of standards.

10. The use of engineering standards as a means to simplification and good order is of major importance to countries whose trained personnel is severely limited in relation to the immense tasks to be tackled when a high proportion of income is being devoted to capital development. The more tasks that can be reduced to routine through reference to accepted specifications, the more time is available for special design and operational problems. Standard equipment means less supervision, less improvisation, less trouble with ordering, replacement and servicing, and a wider field for competitive purchase as supply is not limited to a single firm. From the financial point of view, the standard product should be cheaper to produce and to purchase, and the capital cost of holding stocks can be reduced. Haphazard development of costly installations and the consequent expense of maintenance, modification and the problems of expanding the installations will be avoided.

An important financial saving accrues from the proper use of materials indigenous or imported - based on standards which can provide exact guidance on the types and grades to be used for different purposes, so that equipment and products are neither over nor under-engineered.

11. The fundamental engineering standards are not only means of simplifying and unifying practice but, as already developed nationally and internationally, provide invaluable text books to guide production and engineering services. They illustrate the range of subject matter which can be covered by standards. First there are the standard terms and definitions, symbols and conventions for drawing practice, limits and fits: all these when adopted within a manufacturing or operating unit, and in a country's engineering as a whole, will immensely simplify the understanding of technical specifications on the factory floor, in the setting up of a plant, in tendering to meet contracts, and in the interchange of technical information in purchasing. At the international level - and there is already fairly wide agreement on the details of drawing practice and on the definition of limits and fits - the exchange of technicians, the work of consulting engineers and the supply of plant from different oversea sources will be simplified if a common engineering language is used.

12. Standard methods of test for basic engineering materials-steel, non-ferrous metals-are the next basic requirements, to secure consistent quality and suitability for the purpose to which the materials are to be put. Such standards may also have to deal with sampling procedures and to specify test apparatus. Specifications setting the appropriate limits of performance, in relation to such tests for particular end-uses, complete the data required on materials. Here again international agreement is already considerable.

13. Components in wide general use - fasteners, shafts, jigs, related spanners and tools - all demand common national standards if waste and dislocation are to be avoided. In the case of fasteners, the international picture is of two basic screw thread systems - the ISO (Unified) inch thread, and the ISO metric thread for which standards are now in process of preparation. The difficulties arising from these two systems can be exaggerated, since both have the same thread profile and moreover the nut and bolt in machinery are supplied as a single item, but in any country the eventual aim should be to work on a single system. As things stand, however, with the vast use of both inch and metric threads throughout the world, it would be unwise to adopt so rigid a national policy as to cut off supplies from sources using either the one system or the other.

14. Standards for essential dimensions (for functional interchangeability) and performance of more complex, but widely used engineering equipment (whether produced locally or imported)-electric motors and cables,

machine tools, form another group of basic standards. Here the choice of types, ranges of sizes, ratings etc., is important and the greater the simplification the better, provided there is a reasonable choice within the national standard and the designer is not forced to introduce haphazard variations. Excessive restriction of types may also reduce the element of competition in design and prevent development. It is clear however, that subject to this, the minimum of types and sizes leads to longer manufacturing runs, with consequent economies, better control of quality, less wastage of material, savings in packaging, warehousing stockkeeping and administrative procedures.

15. The final group of standards affecting the general running of engineering industry is that of codes of practice. The benefit from standards which provide for equipment of good quality can be entirely defeated it it is treated in the wrong way. This can be avoided by working to Codes of Practice which lay down standard procedures to be adopted, for example in the installation and maintenance of machinery such as transformers and rectifiers, in the operation of boilers, for identification of pipe lines in the factory, in packaging methods, and in materials handling.

16. A major factor in the efficient running of engineering industry is the confidence of the worker in the safety measures adopted and the steps taken to avoid accidents, as this has a significant effect on his individual output. This confidence will be secured not only by the application of appropriate standards of quality, reliability and safety, to the equipment, machines and tools used such as lifting gear, chains, hooks and slings and hammers or other hand tools, but also by specific standards for safety equipment worn and used by personnel and by safety codes and symbols. Examples are standards for industrial helmets, protective goggles for welding, gloves for electricians, safety boots, together with standard symbols and colours to indicate danger of various kinds.

17. National Standards, then, should be the source of information and guidance on materials and equipment, procedures and practices of the many kinds described, for the individual engineering firm or contractor. These standards must necessarily specify a wider range than any particular manufacturing or operating unit requires, and intelligent and careful selection is necessary for the particular jobs to be done. Selection from a common basis will, however, ensure the advantage of interchangeability between the products of one firm and another and understanding between the firm and its suppliers and customers.

18. This "intelligent" selection from national standards and their application to the requirements of any particular firm or organisation is an important task. It is increasingly recognized in engineering

industry, therefore, that whatever the size of unit there must be a department or individual responsible for settling the firm's standards, based on the national standards. This department or individual should work in close consultation with the departments responsible for design, production, purchase of materials and stores, selling and general administration. The "Standards Engineer" is becoming an accepted category in the engineering world and, within the general lines of policy on what is to be produced or the services to be provided, he will keep a watch on the range of standard products, the cataloguing of parts designed or "bought in", the changes in national standards affecting the company standards which have been laid down and will scrutinize demands for variations from designers and others. Without the rigorous discipline of a standards department or standards engineer there is always a tendency for unnecessary diversity to creep in, for components used by different branches of a concern to be separately specified and ordered, perhaps under different names, and for parallel stocks to be built up, with all the waste of administrative effort, in purchasing, recording and store-keeping.

19. The adoption and application of standards in engineering has so far been considered in its more general aspects, and while emphasis has been laid on the need to master the use of these tools for greater efficiency, the crucial problem of ensuring compliance with specifications on the production floor remains to be considered. A standard sets the precise level of quality reliability or accuracy or dimensioning of the product and must do so in such a way that every one concerned with its achievement can be in no doubt regarding the level which must be reached. The objective of the purchasing firm must be to achieve the requisite quality at minimum cost and to be able to demonstrate to its customers that the quality is consistently achieved. (To play safe by exceeding the quality laid down makes sense neither economically nor technically: too high a quality will not only be expensive but may cause difficulties to the customer because the material will damage or wear out his tools). A standard which not only specifies the quality but also the methods of testing to be employed, the sampling rates and inspection procedures will help the firm to secure these objectives. Standards of this kind, based on sound statistical techniques, are increasingly being developed, particularly as automatic methods of manufacture are adopted.

20. Such standards will indicate the limiting values - e.g. of tensile strength or sulphur content of steel - and also the average values, which it is important for the user to know. They will recognize the inevitability in economic quantity production of a percentage of defectives - if, for example, a product of tensile strength not less than a standard specified value is being produced consistently and without fail, it is almost certain that the target value in the production process has been

set at too high a level or alternatively that the limiting value has been specified at too low a level. The permitted percentage of defectives will vary according to the use for which the material is designed, but with manufacturer and customer in agreement both on the standard of quality and the quality control procedures to be followed, disputes will be avoided. When of course 100 per cent compliance with specified quality is demanded, for items crucial to safety, standard methods of sampling must be replaced by 100 per cent inspection and testing but in large areas of engineering, sampling methods, allied with inspection at crucial stages in manufacture, will be sufficient. Quality control, based on sound standards, will not only help in satisfying the customer, but will also provide the manufacturer with a valuable aid in increasing the efficiency of his production processes.

21. What has been said so far relates to standardization in the national sphere, though some reference has been made to the international recommendations which have been issued - and this work is going on all the time - on engineering standards, Differing national standards can be a most serious barrier to international trade. International co-operation in the alignment of standards has the possibility of yielding great returns. It is as essential to the developing countries as the other forms of international co-operation tor spreading technical knowledge, providing skilled technicians, and providing financial resources and capital equipment. The International Organization for Standardization (ISO) and the International Electrotechnical Commission (I. E. C) are currently responsible for nearly 200 Technical Committees, many of them concerned with engineering, with raw materials and their testing, with building construction and with the equipment and operation of international services such as air transport and communication on which international trade and co-operation depend. The outcome of this work is agreed recommendations to govern the content of national standards, and these already cover a wide field: pipes and fittings, ball and roller bearings, gears, pulleys and belts, machine tools, petroleum products, steel, light metals, rubber and plastics, all types of electrical equipment, aircraft components, airport service requirements. Surveys of national practice have shown the very large extent to which ISO and I. E. C Recommendations are being followed by the countries which aremmembers of these organizations. As in the case of companies using national standards, so the national body must select - and perhaps supplement - the basic specifications laid down by international agreement, but by using them for purchasing and production a country will enlarge its sources of supply, will be able to compare the equipment it is offered and test it on a reliable and uniform basis, will secure a co-ordinated development of its capital equipment and more readily secure acceptance of its exports in world markets.

22. Any country that is developing its economy cannot fail to benefit by co-operation in the work of the international standards organisations and by adopting the internationally agreed recommendations. Valuable as is the experience and research that goes into the preparation of national standards, the collective knowledge that is available in international standards and the wide agreement on practice and techniques that they represent make them indispensible as guides to national standards policy.

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